

AD-A258 251



(1)

DTIC
ELECTE
NOV 25 1992

Hippocampal Modulation of Associative Learning
Grant number N00014-91-J-1764
ANNUAL PROGRESS REPORT
1992

A D

The Columbia College research team is working on several projects connected to the main proposal. The team is lead by Dr. Zafra Lerman, Head, Institute for Science Education and Science Communication and Dr. Geof Goldbogen, Chairman, Academic Computing.

Much of our research is derived from visits to Dr. Nestor Schmajuk's laboratory at Northwestern University and review of his maze-based spatial learning and cognitive mapping experiments. Some of his spatial learning experiments are based on interactive computer display of a problem to be solved.

Our collaboration and interaction with Dr. Schmajuk at Northwestern University suggested two lines of scientific inquiry:

- 1) How changing visual information on the computer — from abstract to more realistic — affects spatial learning;
- 2) Does the performance of "right-brain" oriented people differ from that of "left-brain" oriented people (artistic vs. analytic)?

We were motivated to address the first question after observing that the graphics presentation in Dr. Schmajuk's spatial learning experiments included simplistic wire frame mazes. Our research addressed the issues of:

- How realistic could these mazes be made using personal computers?
- How much effort is required to improve the reality of these mazes?
- How does the improved visual presentation improve the spatial learning?

We have reached the point in our research where we can build virtual reality mazes and study how this affects spatial learning.

This research is being performed by Columbia College students David Morton and Michael Wallisky; results were submitted for presentation in the **Third Annual Argonne Symposium for Undergraduates in Science, Engineering and Mathematics**.

This document has been approved
for public release and sale; its
distribution is unlimited.

425618 92-30238

1005

92 11 24 090

Preliminary tests revealed that artistic-oriented students perform the visual problem solving (hence spatial learning) better than analytic-oriented students. These preliminary results raised the question of any difference in performance between innercity students and suburban students. We are now in the stage of finishing preparation of the tests in order to begin testing hundreds of students to establish a data baseline for these observations.

PUBLICATIONS:

Goldbogen, G., Lerman, Z., Morton, D. and Wallisky, M. An Investigation of the Improvement of Visual Communication and Its Impact on Spatial Learning. Third Annual Argonne Symposium for Undergraduates in Science, Engineering and Mathematics (Submitted: Argonne, Illinois: 1992).

Goldbogen, G., Lerman, Z. and Morton, D. Visualization Skill and Spatial Learning of Analytic- versus Artistic-Oriented People. (To be submitted).

Goldbogen, G., Lerman, Z. and Morton, D. Towards Virtual Reality and Its Impact on Spatial Learning. (To be submitted).

DTIC QUALITY INSPECTED

Accession For	
NTIS	CRA&I
DTIC	TAB
Unannounced	
Justification	
By <i>per Ltr.</i>	
Distribution /	
Availability Order	
Dist	Avail a/c or Special
A-1	

OFFICE OF NAVAL RESEARCH
ANNUAL REPORT
1992

Nestor Schmajuk is working on several projects connected to the main proposal.

In collaboration with Northwestern student James J. DiCarlo, Nestor Schmajuk developed a model of stimulus configuration, classical conditioning, and the hippocampus (Schmajuk and DiCarlo, 1992; communications to two international and two national conferences), that uses a biologically plausible version of backpropagation.

In collaboration with Northwestern student Beth A. Christiansen, Nestor Schmajuk is studying the effect of hippocampal lesions on latent inhibition using the rat eyeblink preparation as described by Schmajuk and Christiansen (1990). This line of research has generated one communication to a scientific meeting (Christiansen and Schmajuk, 1991), a paper in press (Christiansen and Schmajuk, 1992), and a paper in preparation (Schmajuk, Lam, and Christiansen, in preparation).

In collaboration with Professor Jeffrey Gray (Oxford University, University of London), Nestor Schmajuk is developing of a model of latent inhibition (Schmajuk and Gray, in preparation).

In collaboration with Northwestern students Hugh T. Blair and Aaron Thieme, Nestor Schmajuk is working on neural models of hippocampal participation in spatial learning and cognitive mapping (Schmajuk and Thieme, 1992; Schmajuk, Thieme, and Blair, submitted; Schmajuk and Blair, submitted).

In collaboration with Northwestern student David Urry, Nestor Schmajuk developed a neural network model of avoidance. Results of this project will be presented at the meeting of the Psychonomic Society and have been submitted for publication (Schmajuk and Urry, submitted).

In collaboration with Drs. Bruce Perry and Daniel Luchins (University of Chicago), Nestor Schmajuk is studying the effect of hippocampal lesions on dopamine receptors in Nucleus Accumbens and frontal cortex (Perry, Luchins, and Schmajuk, submitted).

In collaboration with Dr. Barry Peterson (Northwestern University), Nestor Schmajuk is modeling plastic mechanisms of the vestibulo-ocular reflex (Quinn, Schmajuk, Baker, and Peterson, 1992; Quinn, Schmajuk, Jain, Baker, and Peterson, 1992).

Nestor A. Schmajuk
1992

Graduate student funded: Hugh T. Blair

PAPERS PUBLISHED

1. Schmajuk, N.A. and DiCarlo, J.J. Stimulus configuration, classical conditioning, and the hippocampus. Psychological Review, 99: 268-305, 1992.
2. Schmajuk, N.A., and Thieme, A.D. Purposive behavior and cognitive mapping: An adaptive neural network. Biological Cybernetics, 67, 165-174, 1992.
3. Quinn, K.J., Schmajuk, N.A., Baker, J.F., and Peterson, B.W. Simulation of adaptive mechanisms in the vestibulo-ocular reflex. Biological Cybernetics, 67, 103-112, 1992.
4. Quinn, K.J., Schmajuk, N.A., Jain, A., Baker, J.F., and Peterson, B.W. Vestibuloocular reflex arc analysis using an experimentally constrained neural network. Biological Cybernetics, 67, 113-122, 1992.

PAPERS IN PRESS

5. Schmajuk, N.A. and Christiansen, B.A. Hippocampectomy disrupts the topography of the rat eyeblink conditioned response during acquisition and extinction of classical conditioning. Brain Research, in press.
6. Schmajuk, N.A. Connectionist approaches to the mind. Contemporary Psychology, in press.

PAPERS SUBMITTED

7. Schmajuk, N.A., Thieme, A.D., and Blair, H.T. Role of the hippocampus in spatial learning and cognitive mapping: A neural network approach. Hippocampus.
8. Schmajuk, N.A., and Blair, H.T. The dynamics of spatial navigation: An adaptive neural network. From Animats to Animals.
9. Perry, B., Luchins, D., and Schmajuk, N.A. Altered Dopamine receptor binding site densities in rat brain following hippocampal lesions. Brain Research.
10. Schmajuk, N.A., and Urry, D. Avoidance revisited: A neural network approach. Psychological Review.

PAPERS IN PREPARATION

11. Schmajuk, N.A., Lam, P., and Christiansen, B.A. Hippocampal lesions disrupt latent inhibition in the rat eyeblink preparation.
12. Schmajuk, N.A., and Gray, J.A. Latent inhibition: A neural network approach.

COMMUNICATIONS TO SCIENTIFIC MEETINGS

1. Schmajuk, N.A., & Thieme, A. A neural network approach to cognitive mapping. Thirty-second Annual Meeting, The Psychonomics Society, San Francisco, California, November 22-24, 1991.
2. Schmajuk, N.A. Backpropagation, classical conditioning, and hippocampal function. XXV International Congress of Psychology. Brussels, 19-24 July, 1992.
3. Schmajuk, N.A., & Thieme, A. Cognitive mapping: A neural network approach. Sixty-fourth Annual Meeting of the Midwestern Psychological Association, Chicago, IL, April 30-May 2, 1992.
4. Schmajuk, N.A. Backpropagation and hippocampal function. Meeting of the British Experimental Psychology Society, York, United Kingdom, July 1992.
5. Schmajuk, N.A., & Urry, D.W. Escape and avoidance revisited: A neural network approach. Thirty-third Annual Meeting, The Psychonomics Society, St. Louis, Missouri, November 13-15, 1992.
6. Christiansen, B.A., and Schmajuk, N.A. Hippocampal lesions disrupt latent inhibition. Twenty Second Annual Meeting, Society for Neuroscience, Anaheim, California, October 25-30, 1992.

**Hippocampal Modulation of Associative Learning
Grant number N00014-91-J-1764
ANNUAL PROGRESS REPORT
1992**

The Columbia College research team is working on several projects connected to the main proposal. The team is lead by Dr. Zafra Lerman, Head, Institute for Science Education and Science Communication and Dr. Geof Goldbogen, Chairman, Academic Computing.

Much of our research is derived from visits to Dr. Nestor Schmajuk's laboratory at Northwestern University and review of his maze-based spatial learning and cognitive mapping experiments. Some of his spatial learning experiments are based on interactive computer display of a problem to be solved.

Our collaboration and interaction with Dr. Schmajuk at Northwestern University suggested two lines of scientific inquiry:

- 1) How changing visual information on the computer — from abstract to more realistic — affects spatial learning;
- 2) Does the performance of "right-brain" oriented people differ from that of "left-brain" oriented people (artistic vs. analytic)?

We were motivated to address the first question after observing that the graphics presentation in Dr. Schmajuk's spatial learning experiments included simplistic wire frame mazes. Our research addressed the issues of:

- How realistic could these mazes be made using personal computers?
- How much effort is required to improve the reality of these mazes?
- How does the improved visual presentation improve the spatial learning?

We have reached the point in our research where we can build virtual reality mazes and study how this affects spatial learning.

This research is being performed by Columbia College students David Morton and Michael Wallisky; results were submitted for presentation in the **Third Annual Argonne Symposium for Undergraduates in Science, Engineering and Mathematics**.

Preliminary tests revealed that artistic-oriented students perform the visual problem solving (hence spatial learning) better than analytic-oriented students. These preliminary results raised the question of any difference in performance between innercity students and suburban students. We are now in the stage of finishing preparation of the tests in order to begin testing hundreds of students to establish a data baseline for these observations.

PUBLICATIONS:

Goldbogen, G., Lerman, Z., Morton, D. and Wallisky, M. An Investigation of the Improvement of Visual Communication and Its Impact on Spatial Learning. Third Annual Argonne Symposium for Undergraduates in Science, Engineering and Mathematics (Submitted: Argonne, Illinois: 1992).

Goldbogen, G., Lerman, Z. and Morton, D. Visualization Skill and Spatial Learning of Analytic- versus Artistic-Oriented People. (To be submitted).

Goldbogen, G., Lerman, Z. and Morton, D. Towards Virtual Reality and Its Impact on Spatial Learning. (To be submitted).

OFFICE OF NAVAL RESEARCH
ANNUAL REPORT
1992

Nestor Schmajuk is working on several projects connected to the main proposal.

In collaboration with Northwestern student James J. DiCarlo, Nestor Schmajuk developed a model of stimulus configuration, classical conditioning, and the hippocampus (Schmajuk and DiCarlo, 1992; communications to two international and two national conferences), that uses a biologically plausible version of backpropagation.

In collaboration with Northwestern student Beth A. Christiansen, Nestor Schmajuk is studying the effect of hippocampal lesions on latent inhibition using the rat eyeblink preparation as described by Schmajuk and Christiansen (1990). This line of research has generated one communication to a scientific meeting (Christiansen and Schmajuk, 1991), a paper in press (Christiansen and Schmajuk, 1992), and a paper in preparation (Schmajuk, Lam, and Christiansen, in preparation).

In collaboration with Professor Jeffrey Gray (Oxford University, University of London), Nestor Schmajuk is developing of a model of latent inhibition (Schmajuk and Gray, in preparation).

In collaboration with Northwestern students Hugh T. Blair and Aaron Thieme, Nestor Schmajuk is working on neural models of hippocampal participation in spatial learning and cognitive mapping (Schmajuk and Thieme, 1992; Schmajuk, Thieme, and Blair, submitted; Schmajuk and Blair, submitted).

In collaboration with Northwestern student David Urry, Nestor Schmajuk developed a neural network model of avoidance. Results of this project will be presented at the meeting of the Psychonomic Society and have been submitted for publication (Schmajuk and Urry, submitted).

In collaboration with Drs. Bruce Perry and Daniel Luchins (University of Chicago), Nestor Schmajuk is studying the effect of hippocampal lesions on dopamine receptors in Nucleus Accumbens and frontal cortex (Perry, Luchins, and Schmajuk, submitted).

In collaboration with Dr. Barry Peterson (Northwestern University), Nestor Schmajuk is modeling plastic mechanisms of the vestibulo-ocular reflex (Quinn, Schmajuk, Baker, and Peterson, 1992; Quinn, Schmajuk, Jain, Baker, and Peterson, 1992).

Nestor A. Schmajuk
1992

Graduate student funded: Hugh T. Blair

PAPERS PUBLISHED

1. Schmajuk, N.A. and DiCarlo, J.J. Stimulus configuration, classical conditioning, and the hippocampus. Psychological Review, 99: 268-305, 1992.
2. Schmajuk, N.A., and Thieme, A.D. Purposive behavior and cognitive mapping: An adaptive neural network. Biological Cybernetics, 67, 165-174, 1992.
3. Quinn, K.J., Schmajuk, N.A., Baker, J.F., and Peterson, B.W. Simulation of adaptive mechanisms in the vestibulo-ocular reflex. Biological Cybernetics, 67, 103-112, 1992.
4. Quinn, K.J., Schmajuk, N.A., Jain, A., Baker, J.F., and Peterson, B.W. Vestibuloocular reflex arc analysis using an experimentally constrained neural network. Biological Cybernetics, 67, 113-122, 1992.

PAPERS IN PRESS

5. Schmajuk, N.A. and Christiansen, B.A. Hippocampectomy disrupts the topography of the rat eyeblink conditioned response during acquisition and extinction of classical conditioning. Brain Research, in press.
6. Schmajuk, N.A. Connectionist approaches to the mind. Contemporary Psychology, in press.

PAPERS SUBMITTED

7. Schmajuk, N.A., Thieme, A.D., and Blair, H.T. Role of the hippocampus in spatial learning and cognitive mapping: A neural network approach. Hippocampus.
8. Schmajuk, N.A., and Blair, H.T. The dynamics of spatial navigation: An adaptive neural network. From Animats to Animals.
9. Perry, B., Luchins, D., and Schmajuk, N.A. Altered Dopamine receptor binding site densities in rat brain following hippocampal lesions. Brain Research.
10. Schmajuk, N.A., and Urry, D. Avoidance revisited: A neural network approach. Psychological Review.

PAPERS IN PREPARATION

11. Schmajuk, N.A., Lam, P., and Christiansen, B.A. Hippocampal lesions disrupt latent inhibition in the rat eyeblink preparation.
12. Schmajuk, N.A., and Gray, J.A. Latent inhibition: A neural network approach.

COMMUNICATIONS TO SCIENTIFIC MEETINGS

1. Schmajuk, N.A., & Thieme, A. A neural network approach to cognitive mapping. Thirty-second Annual Meeting, The Psychonomics Society, San Francisco, California, November 22-24, 1991.
2. Schmajuk, N.A. Backpropagation, classical conditioning, and hippocampal function. XXV International Congress of Psychology. Brussels, 19-24 July, 1992.
3. Schmajuk, N.A., & Thieme, A. Cognitive mapping: A neural network approach. Sixty-fourth Annual Meeting of the Midwestern Psychological Association, Chicago, IL, April 30-May 2, 1992.
4. Schmajuk, N.A. Backpropagation and hippocampal function. Meeting of the British Experimental Psychology Society, York, United Kingdom, July 1992.
5. Schmajuk, N.A., & Urry, D.W. Escape and avoidance revisited: A neural network approach. Thirty-third Annual Meeting, The Psychonomics Society, St. Louis, Missouri, November 13-15, 1992.
6. Christiansen, B.A., and Schmajuk, N.A. Hippocampal lesions disrupt latent inhibition. Twenty Second Annual Meeting, Society for Neuroscience, Anaheim, California, October 25-30, 1992.